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A61M 15/00

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A5T T82

(56) Documents Cited
EP 0645419 A1

(58) Field of Search
UK CL (Edition N) A5T T82 T8E
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ONLINE:WPI

(54) Actuator for breath-actuated medicament dispenser

(57) The actuator, which fits on the housing 10 of a metered dose inhaler, comprises a latching device 18 having resilient latch members 22 and a piston 26 fitting partially within a cap 28 of the housing. The piston has a flange 26C co-operable with head portions 22B of the latch members and the housing wall has an abutment 38 engagable with head portions 22A of such members. The latching device also has depending legs 42 engagable with cams 44, 46 on hinged cap 16. A spring 48 acts between cap 28 and the latching device for axial movement of an aerosol can 12. When air is inhaled at mouthpiece 14, air flow through inlets 30 causes a pressure drop across the piston which moves downwardly to release the latch members which are then free to move inwardly and allow the spring to drive down the latching device and can. Closing of the cap 16 then resets the device via cam rotation.

FIG.1

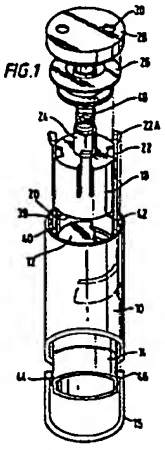


FIG.2A

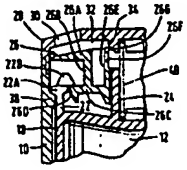


FIG.1

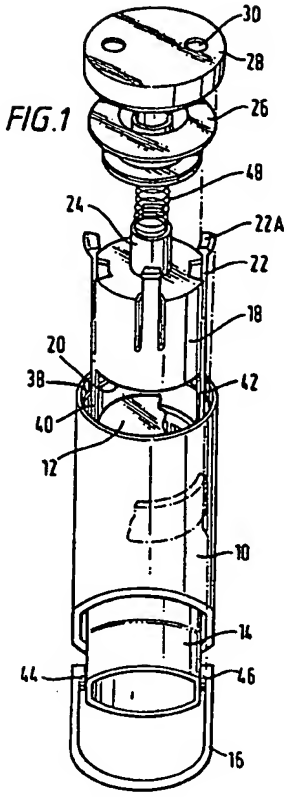


FIG.2A

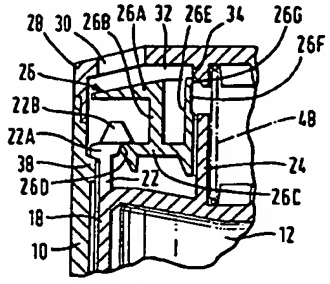


FIG.2B

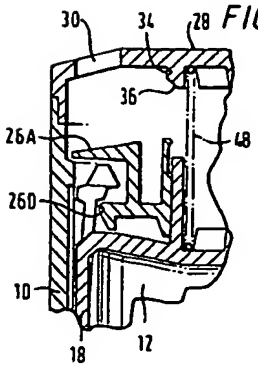


FIG.2C

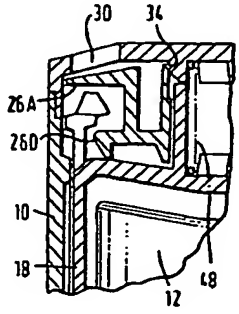


FIG.3C

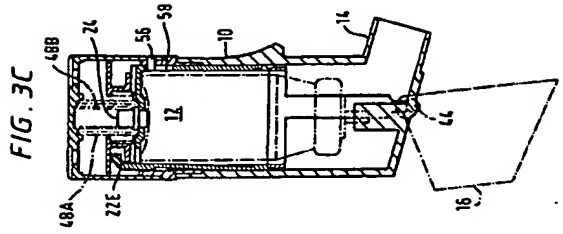


FIG.3B

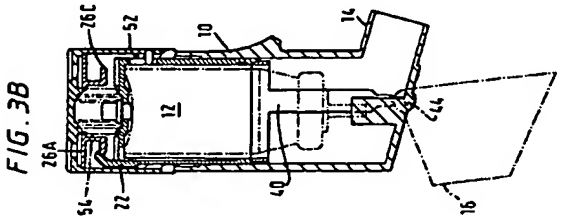


FIG.3A

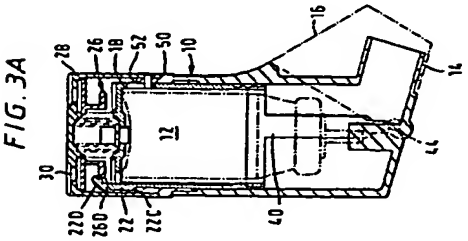


FIG. 4

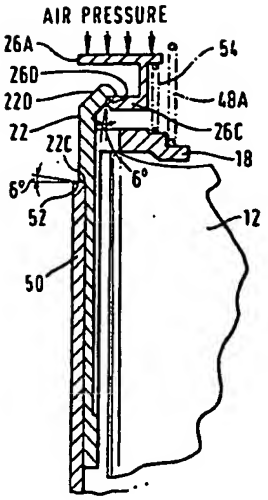


FIG. 5A

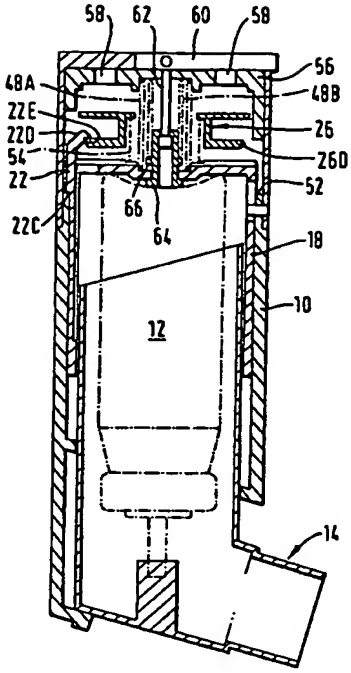


FIG. 5B

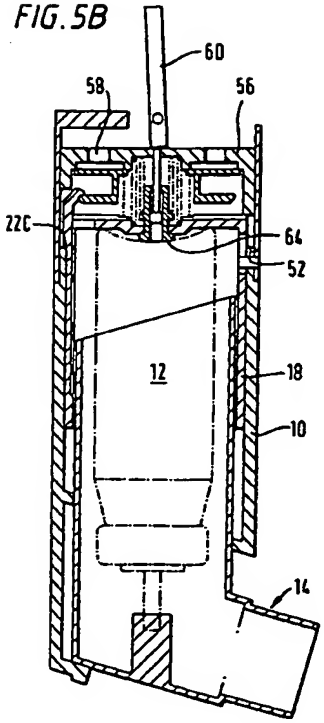


FIG. 5C

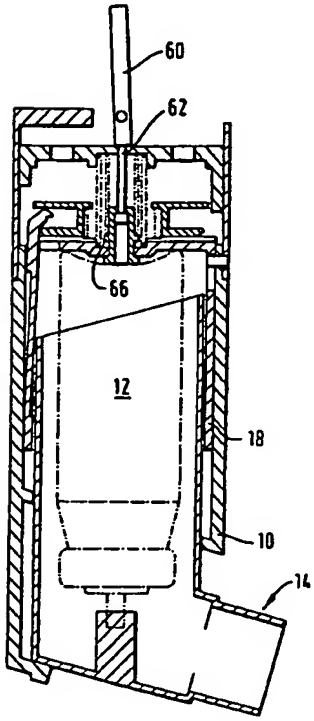


FIG. 6

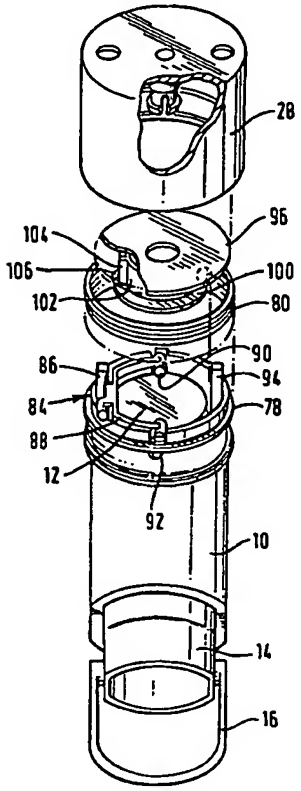


FIG. 7A

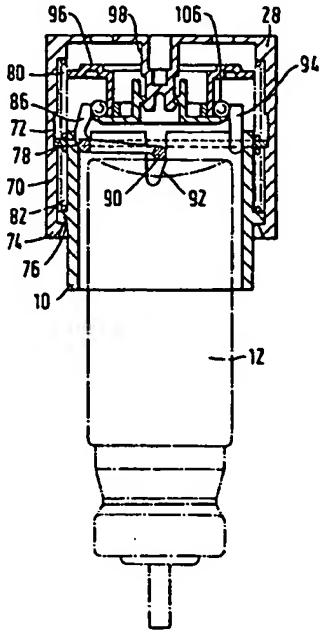


FIG. 7B

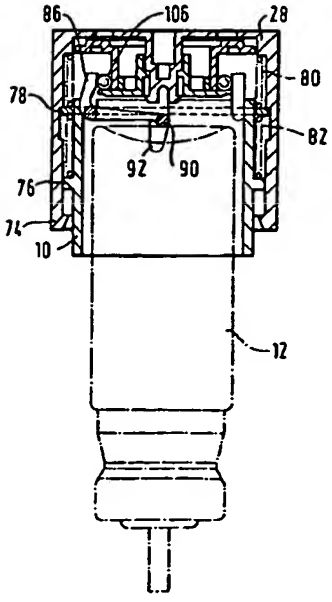


FIG. 7C

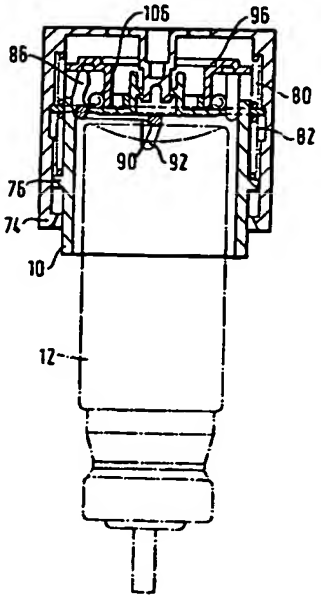


FIG. 7D

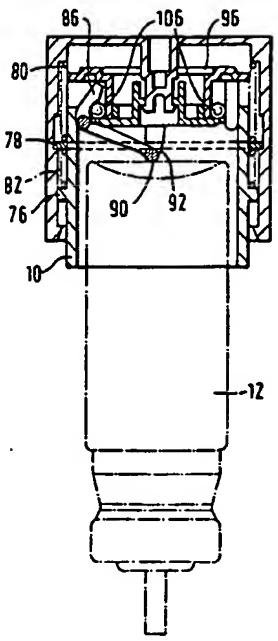


FIG. 7E

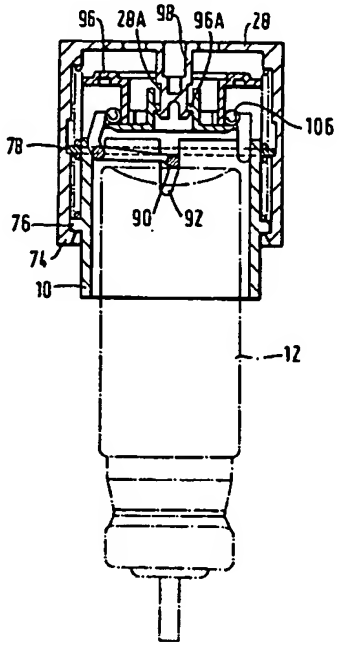


FIG. 8

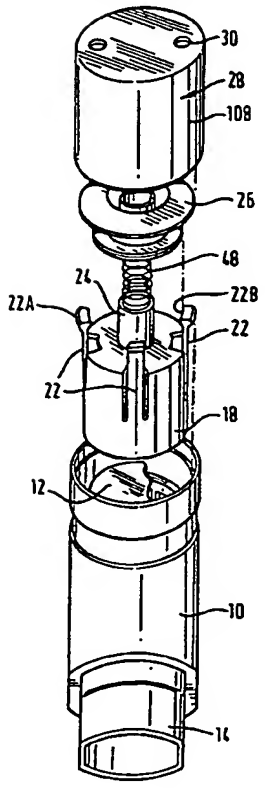


FIG. 9A

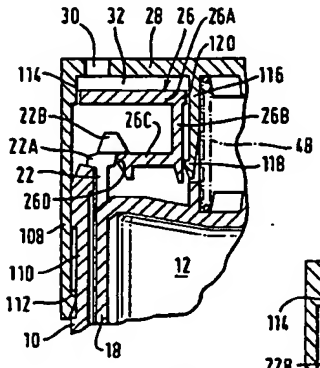
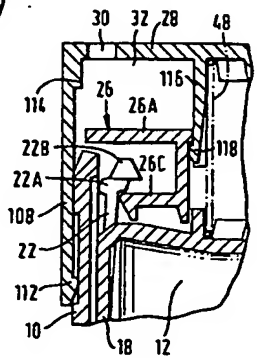


FIG. 9B



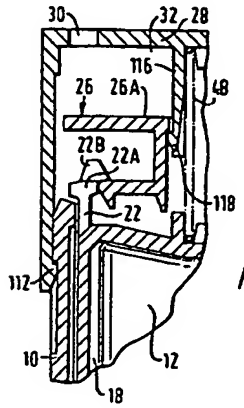


FIG. 9C

2292891

MEDICAMENT ADMINISTRATION INHALER

The present invention relates to an inhaler for the administration of medicaments, for example from pressurized containers such as aerosol cans, or from a dry powder medicament dispensing device.

Medicament administration inhalers are known in which a metering device is incorporated in order to dispense a metered dose of medicament from a pressurized container.

Certain difficulties have been recognized with some known forms of inhaler. For example it is necessary for a patient to ensure that the dose of medication is dispensed at the same time that the patient inhales air. If the medication dose is dispensed whilst the patient is exhaling then the patient will not receive any medication or only a partial amount of medication.

It has also been proposed to provide an inhaler in which the medication dose is dispensed automatically when the patient inhales. Such inhalers incorporate a member which can move in response to a pressure differential caused by a patient inhaling. The movement of the member operates a mechanism to apply a force to the pressurized container.

EP-0,045,419 utilizes a latching arrangement in which a rigid over-centre mechanism is used to support the latch fingers. The mechanism geometry creates the locking action to be released by movement of a breath-actuated piston. In practice an over-centre mechanism would be required to ensure proper operation of mass produced devices. However this increases the force required to fire the device and reduces its sensitivity. If an in-line mechanism is adopted, as illustrated, extremely small tolerances would be required to ensure consistency of operation of mass produced devices. This would lead to high manufacturing and assembly costs. Moreover this structure is relatively complicated involving a

considerable number of components. GB-1,270,272 utilizes a form of breath-actuated over-centre release mechanism.

US-5,133,343 and US-4,803,978 utilizes a pivotal thrust plate having a cam provided on an axle thereof, which is latched by a rocker arm. A breath actuated vane releases the rocker arm from the cam on inhalation. It is relatively difficult to produce a particularly sensitive actuating device with this construction. A similar construction is illustrated in GB-2,204,799 or US-5,119,806.

WO-85/01880 utilizes a relatively complicated latching mechanism released by a pivotally mounted vane located in the mouthpiece of the device. Once again it is relatively difficult to produce a particularly sensitive release mechanism with this construction. Location of the mechanism near the mouthpiece is less desirable because any piece which breaks off during use could be inhaled.

GB-1,269,554; GB-1,269,811; GB-1,288,971; GB-1,297,993; GB-1,335,378 and GB-1,383,761 disclose relatively complicated release mechanisms located in compartments located alongside the chamber for receiving the aerosol can, which increases the bulk of the devices.

The present invention seeks to provide an improved medication administration inhaler in which the medication dose is administered as the patient inhales.

The present invention also seeks to provide an inhaler in which the actuating mechanism is less reliant on small dimensional tolerances and is significantly simpler to produce.

Accordingly the present invention provides an actuator for use with a medicament dispensing device having a housing for receiving a medicament delivery system which can be operated by the actuator to deliver doses of medicament, and a nozzle through which doses of medicament are inhaled in use, the actuator comprising a body part containing at least one means for applying a force, or a cumulative force, to the medicament delivery system sufficient to cause delivery therefrom of a dose of medicament; releasable restraining

means for restraining the, or at least one of the, force applying means to prevent application of a force, or cumulative force, to the medicament delivery system sufficient to deliver a dose of medicament, the restraining means including a latching device acting between the, or said one, force applying means and said body part, and having a latching part which is movable generally transversely of the line of action of said force, between an engaged condition in which the restraining means restrains said force as aforesaid and a disengaged condition in which the restraining means is released with the latching part being biassed towards said disengaged position; and breath actuated control means for the restraining means, said control means being mounted in the body part for movement, under the influence of a reduced pressure acting thereon caused by inhalation at the nozzle, between a first position in which it blocks movement of said latching part to maintain it in said engaged condition, and, on the application thereto of said reduced pressure, a second position in which it disengages from, and moves clear of the path of movement of, the latching part allowing the latching part to move to said disengaged condition to release said restraining means.

Said control means preferably comprises a member, e.g., a plate, a piston or a membrane, mounted in said body part for movement generally along the line of action of said force, under the influence of said reduced pressure.

Said latching part may be engageable with an abutment provided on said body part in said engaged condition thereof.

Said latching part and said abutment may have cooperating abutment surfaces which are set at an angle to the line of action of said force so as to cause movement of the latching part to said disengaged condition under the action of said force applying means on release of said control means.

The piston may include biassing means biassing it towards said first position.

In some embodiments, there may be provided a first force applying means for applying a preload to the medicament

delivery system which is insufficient to cause delivery therefrom of a dose of medicament, and a second force applying means which is restrained by said releasable restraining means, said first and second force applying means being capable of applying a cumulative force to said medicament delivery system, on release of said restraining means, sufficient to cause discharge therefrom of a dose of medicament.

The latching device may be integral with a thrust member, on which said one force applying means acts, said thrust member together with the latching device being movably mounted in said body part for movement generally along the line of action of said force, when said latching part is moved to said disengaged condition thereof.

The latching part may be resilient to allow movement thereof between said engaged and disengaged conditions thereof.

The invention also provides an inhaler having a generally tubular housing for receiving a medicament delivery system, and a nozzle which communicates with one end of the housing and through which doses of medicament are inhaled in use, and an actuator according to the invention for actuating a medicament delivery system located in use in said housing to deliver doses of medicament for inhalation at the nozzle.

The body part of the actuator may comprise a cap located at the other end of the housing.

The cap may be fixed with respect to, or integral with, said housing.

In some embodiments, engageable abutment means may be provided between said control means and said latching part, and resilient engagement means may be provided for releasably engaging said control means with a part of said cap, during resetting of the actuator.

The cap may be movably mounted on the housing, for setting and resetting the actuator. Engageable abutment means may be provided between the cap and said control means and between said control means and said latching part for

resetting the actuator when the cap is lifted with respect to the housing.

In other embodiments, there may be provided a movable portion mounted on the cap and operable to depress an internal axially movable member within the housing in order to expose inlet air holes in that member, and to set the actuator.

The present invention will now be more particularly described with reference to the accompanying drawings in which:

Figure 1 shows an exploded perspective view of one form of actuator according to the present invention;

Figures 2A to 2C show details of the actuator shown in Figure 1 in three positions of operation;

Figures 3A to 3C show a second form of actuator according to the present invention in three positions of operation;

Figure 4 shows a portion of the actuator shown in figures 3a to 3c in greater detail;

Figures 5a to 5c show a third form of actuator according to the present invention in three stages of operation;

Figure 6 shows an exploded perspective view of a fourth form of actuator according to the present invention;

Figures 7a to 7e show the actuator shown in figure 6 in five positions of operation;

Figure 8 shows a fifth form of actuator according to the present invention; and

Figures 9a to 9c show the actuator shown in figure 8 in three positions of operation.

Referring to figures 1 and 2a to 2c there is shown an actuator for an aerosol can. The actuator is a self contained unit which is intended to be fitted on top of a housing (10) of a metered dose inhaler which contains an aerosol can (12), and has at its lower end a mouth piece (14) on which is hingedly mounted a cap (16). In use medicament is inhaled in an air stream through the mouth piece (14) and the cap (16) opens and closes access to the mouth piece (14).

The actuator comprises a cylindrical latch device (18) which is generally cup shaped having a downwardly open mouth (20) which receives an upper portion of the aerosol can (12). A series of four circumferentially spaced resilient latching members (22) are integrally formed on the cup member together with an upwardly projecting hollow boss (24).

The resilient latch members (22) have a T-shaped head portion (22A) with a retaining rib (22B) formed on the upper surface thereof.

The actuator further comprises a piston member (26) having an annular upper portion (26A) which generally fits within a cap (28) which is attached to the housing (10). The cap (28) has air inlet apertures (30) which communicate with a cylindrical chamber (32) within the cap and in which the piston (26) is located.

The piston (26) has an annular depending portion (26B) provided towards its lower end with an annular flange (26C) having a rounded rim (26D) for co-operating with the head portions (22B) of the resilient latch members (22).

The piston (26) also has an inner circular wall (26E) which terminates in a resilient limb (26F) having a pip (26G) at its free end for engaging in a depression (34) formed in an annular boss (36) provided on the underside of the cap (28).

The wall of the housing (10) is provided with an internal annular abutment (38) for engaging with the head portions (22A) of the latch members (22).

The cup shaped latching device (18) is provided with a pair of elongate depending legs (40,42) which engage with cams (44) and (46) on the cap (16). The cams (44, 46) are positioned eccentrically with respect to the axes of the cap (16).

A driving spring (48) acts between the cap (28) and the latching device (18) and is of sufficient strength to move the aerosol can (12) axially by a sufficient amount to open the aerosol can valve in order to release a dose of medicament into an air stream inhaled in use through the mouth piece (14).

The operation of the actuator will now be described with reference to figures 2a to 2c.

Figure 2a shows the "set" position of the device ready for release of a dose of medicament when an air stream is inhaled through the mouth piece (14). In this position the resilient head portions (22a) of the latch members (22) are engaged with the annular abutment (38) on the wall of the housing (10) and are held in this position by the rounded rim (26D) of the annular flange (26C) of the piston (26).

The piston (26) is located towards the lower end of the chamber (32) and is maintained in this position by frictional engagement between the rounded rim (26D) of the flange (26C) and the co-operating surface of the head portions (22A) (22B) of the latch members (22). This frictional engagement which maintains the piston (26) from dropping is achieved by selecting suitable angles for the co-operating surfaces between the latch member head portions (22A) and the upper surface of the abutment (38), and between the rounded rim (26D) of the flange (26C) on the piston (20) and the juxta posed surfaces of the latch member heads (22B).

The angles of these co-operating surfaces are selected in accordance with the friction co-efficients of the surfaces of the members concerned so that the piston does not move in this position. With the latch device (18) held in the position shown in figure 2A by the engagement of the head portions (22A) of the latch members (22) with the upper end of the housing wall (10), the firing spring (48) is held sufficiently compressed to ensure that the valve of the aerosol can (12) is not opened in this condition.

When an air stream is inhaled through the housing mouth piece (14), air flows through the inlets (30) and a pressure drop is experienced across the piston (26) so that it is moved downwardly to release the frictional engagement between the

flange (26C) and head portions (22A) of the resilient latch members (22) to bring the device into the "fired" condition shown in figure 2b. In this condition, the latch members (22) are now free to move resiliently inwardly and out of engagement with the abutment (38) on the wall of the housing (10). This allows the latch member (18) to be moved downwardly by the firing spring (48) which causes axial depression of the aerosol can (12). This results in opening of the valve of the aerosol can to dispense a dose of medicament into the inhaled air stream in the mouth piece (14).

In order to bring the device into the reset position as shown in figure 2C, the mouth piece cover (16) is closed by rotation causing rotation of the cams (44) and (46) which lifts the latching device (18) by means of the legs (40) and (42) thereby compressing the firing spring (48) until the piston (26) is connected to the cap (28) by resilient engagement of the pips (26G) in the depressions (34) formed in the boss (36). This is caused by engagement of the base of the latch member (18) with a downwardly depending edge provided on the piston flange (26E).

The device is "set" by again opening the mouth piece cover (16) whereby the latch device (18) is driven downwardly by the firing spring (48) until the ribs (22A) on the latching members (22) engage the abutment (38) on the wall of the housing (10), pulling the piston downwardly with respect to the cap (28) with

disengagement of the resilient fingers (26F) from the depressions (34) in the boss (36). The device is then in the "set" position shown in figure 2A for a further operation thereof.

Modifications of this embodiment are possible, for example the mouth piece (14) may be formed in line with the actual direction of the housing body (10) rather than at an angle crank thereto is shown in figure 1.

Furthermore the actuator mechanism could be located at the bottom of the housing (10) so that the latching device (18) acts to support the underside of the aerosol can in its latched condition against the action of the firing spring (48).

Referring now to figures 3A to 3C and figure 4, there is shown a second embodiment of an action actuator which is similar to that shown in the first embodiment. This actuator is incorporated into the structure of the inhaler housing (10) provided with a pivotally mounted cover (16) for opening and closing access to the mouth piece (14) of the inhaler.

Generally the construction of the actuator is very similar to that shown in the first embodiment and the same reference numerals will be used for similar parts. The following description will be restricted generally to the distinctions between the two embodiments.

The cap (28) is attached to the container (10) by means of an intermediate sleeve (50) to create an annular shoulder (52) which performs the same function as the abutment (38) in the first embodiment.

The resilient latch members (22) have a corresponding shoulder (22C) and a head portion (22D) formed with a recess (22E) which co-operates with the rim (26D) of the piston flange (26C). Inclined planes of contact are formed between the faces (22G) and the shoulder (50), and the rim (26D) and the recesses (22D) as will be described with reference to figure 4.

In this embodiment three springs are provided namely a piston spring (54) located between the piston (26) and the upper surface of the latching device (18) and he firing spring (48A and 48B) which extend between the cap (28) and the upper surface of the latching device (18), in a similar manner to that described with reference to the first embodiment. As will be described the spring (54) urges the piston (26) in an upward direction in order to engage the rim (26D) of the flange (26C) in the recesses (22E) of the latching members (22).

The latching device (18) is capable of limited axial movement with respect to the housing (10). The movement is limited by means of a pin (56) which extends through the wall of the

housing, and engages a slot (58) formed in the cylindrical wall of the latching device (18).

The device is shown in the "closed" position in figure 3A and the cap (16) is closed. The lower ends of the legs (40) (42) are in contact with the surfaces of the cams (44) (46) which positions the latching device (18) such that the surfaces (22C) on the latching members (22) are spaced from the surface (52) and the rim (26D) of the piston flange (26C) is disengaged from the recesses (22E) on the latching members (22). This latter position of the piston (26) is achieved by the spring (54) urging the piston upwardly into engagement with the under surface of the cap (28), and the force of the firing springs (48A), 48B) is reacted by the contact between the legs (40, 42) and the cams (44, 46).

Referring to figure 4 in particular it will be seen that a circumferentially extending annular plane of contact exists between the surfaces (22C) on the latching members (22) and the shoulder (52). This plane of contact is inclined at an angle of 6° to the horizontal. A similar plane of contact, inclined at 6° to the vertical also exists between the contact surface on the head portions (22D) and the rounded rim (26D) on the flange (26C0 of the piston (26).

In order to bring the device in the "set" position shown in

figure 3B the cover cap (16) is rotated which allows the latching device (18) to move downwardly so that the surfaces (22C) on the latching members (22) engage the annular surface (52) on the wall of the housing (10) and the rim (26D) of the piston flange (26C) engages in the recesses (22E) of the latching members (22), as the spring (54) maintains the piston (26) in contact with the undersurface of the cap (28). Thus the downward movement of the latching device (18) causes the heads (22D) of the latching members (22) to contact the annular rim (26D) of the piston flange (26C). The legs (40, 42) are no longer in contact with the cams (44, 46) and the force of the firing springs (48A, 48B) is reacted at the contact plane between the surfaces (22C0 and the rim (52).

The device is in the "fired" position as shown in figure 3c. Upon the application of inhalation to the mouth piece (14) air will flow through the inlets (30) and there will be a pressure drop across the piston (26). The piston will be caused to move downwardly against the force of the spring (54) and the rim (26D) of the piston flange (26C) will disengage from the recesses (22E) allowing latching members (22C) to move inwardly and disengage from the annular surface (52). The firing spring, (48A, 48B) will then operate to force the latching device (18) together with the aerosol can (12) downwardly thereby opening the valve of the aerosol can and delivering a dose of medicament into the inhaled air stream through the mouth piece (14). The downward motion of

the latching device (18) and thus the aerosol can is limited by contact between the legs (40, 42) and the cams (44, 46).

The size of the reactions depend upon the angles between the components and the co-efficents of friction. The forces can be calculated and optimised so the effects of dimensional variations are minimized, and effects of variations of co-efficients of friction are minimized. In the present designs, the interface angles are about 6^{0} as has been described and the co-efficient of friction between the components is about 0.075. These values can be achieved using polytetrafluoro ethylene (PTFE) coated acetal components, or by using PTFE filled acetal and PTFE filled nylon.

The device is returned to the "closed" position as shown in figure 3A by rotation of the cap (16) and the engagement of the legs (40) (44) with the cams (44) (46) on the cover cap (16). By this engagement the latching device (18) will be moved upwardly forcing the latching members (18) into the position shown in figure 3A and compressing the firing springs (48A 48B) and allowing the spring (54) to urge the piston (26) into contact with the under surface of the cap (28).

It will be appreciated that the reaction of the load exerted by the firing springs (48A), (48B) at the interface between the surfaces (22C) on the latch members (22) and the shoulder (52) on the body (10) results in a force urging the latch members (22)

inwardly. A force is thus exerted on the piston (26), and is reacted at the interface between the recesses (22E) and the run (26D) on the piston (26). A downwards force is thereby exerted in the piston (26) which is reacted by the piston spring (54).

Referring now to figures 5A to 5C there is shown a third embodiment of an actuator which is similar to that shown in the second embodiment. The construction of the actuator is generally very similar to that shown in the second embodiment and the same reference numerals will be used for similar parts. In this arrangement the upper cap of the device is modified to provide a function similar to that provided by rotation of the cover caps (16) in the previous embodiments.

Referring to figures 5A to 5C which show the "closed", "set" and "fired" positions of the device respectively, the device includes an internally mounted axially movable cap (56) provided with air inlets (58) and being in sliding engagement with the internal walls of the housing (10).

The device has a lever (60) which is secured to the housing (10) to which is attached a plunger (62) engageable with the internal bore of a boss (64) attached centrally to the base of the latching device (18). The lower end of the boss (64) bears against the bottom of the aerosol can (12) and the boss (64) has an annular shoulder (66) against which the lower end of the

firing spring (48B) bears. The upper end of this spring and the upper end of the spring (48A) bearing against the under surface of the axially movable cap (56). The lower end of the spring (48) bears against the upper surface of the latching member (18) in a similar manner to that described with reference to the previous embodiment.

Referring to figure 5A which shows the device in the "closed" the lever (60) is in the closed position and the axially moveable cap member (56) is urged against the undersurface of the fixed cap by the firing springs and the spring (54) urges the piston (26) in an upward direction so that the rim (26D) of the piston flange (26C) engages with the recesses (22E) in the heads (22D) of the latch members (22).

The force of the firing springs (48A, 48B) is reacted by engagements of the plunger (62) with the boss (64).

In order to bring the device into the "set" position as shown in figure 5B the lever (60) is pivoted so that one end of the lever bears against the upper surface of the axially cap member (56) and urges the cap member (56) downwardly within the housing (10) thereby opening up the air inlets (58) and loading the firing springs (48A) and (48B). As the plunger (62) is disengaged from the boss (64), the force of the firing springs (48, 48B) is now reacted at the contact plans between the surfaces (22C) and the

shoulder (52).

Upon inhalation through the mouth piece (14) air is drawn through the air inlets (58) and causes a pressure drop across the piston (26). The piston moves downwardly against the force of the spring (54) so that the rim (26D) of the piston flange (26C) is disengaged from the recesses (22E) allowing the latch members (22) to move inwardly disengaging the surfaces (22C) from the annular shoulder (52). The firing springs (48A) and (48B) operate thereby forcing the aerosol can (12) downwardly and opening the aerosol can valve in order to dispense a medicament dose into the air being inhaled through the mouth piece (14).

In order to restore the device to the closed position (fig. 5A) the lever (16) is returned to the position shown in figure 5A and the firing springs (48A) and (48B) move the cap (56) upwardly so that it engages the under surface of the fixed cap and the spring (54) operates to move the piston (26) upwardly so that the rim (26D) of the piston flange (26C) engages the recesses (22F) in the latching members (22) thereby forcing the latch members outwardly in order to engage the shoulder (22C) with the surface (52).

Figures 6 and 7A to 7E illustrate a fourth embodiment of a self-contained actuator for location on an inhaler housing containing an aerosol can.

The cap (28) has a relatively shallow internal annular recess (70) which in turn has a relatively deep narrower internal recess (72) disposed centrally thereof. The lower edge of the cylindrical wall of the cap (28) has an annular flange (74) which is in the REST position (figure 7A) engages an annular abutment (76) on the wall of the housing. An annular washer (78) is engaged at its periphery for sliding movement in the relatively deep recess (72) in the internal cap wall. A firing spring (80) acts between the upper end of the relatively shallow recess (70) in the cap wall and the washer (78). A return spring (82) acts between the abutment (76) and the washer (78).

A latching assembly (84) is mounted at the upper end of the housing wall. The latching assembly (84) comprises a pivotally mounted latch device having an upwardly projecting latch member (86) and formed integrally therewith a bifurcated member (88) formed at the free end of its limbs with a pair of trunnions (90) which are movable in arcuate slots (92) formed in the upper edge of the housing wall. The latching assembly (84) can therefore pivot between a position in which the latch member (86) is generally upright with the trunnions at the upper ends of slots (92) to a position in which the latch member (86) is directed radially inwardly of the housing wall with the trunnions (90) at the lower ends of slots (92). The latching assembly also comprises an upstanding reaction block (94) projecting upwardly of the end of the housing wall (10) at a position diametrically

opposite that of the pivotally mounted latch member (86).

The assembly also comprises a piston (96) having an upper annular portion encircling a downwardly depending boss (98) provided centrally on the base portion of the cap (28), and a lower annular portion (100) secured to the upper portion by a cylindrical connecting wall portion (102). At diametrically opposed locations on the connecting wall, a pair of parallel channels (104) are formed to contain therein balls (106).

The washer (78) is located to engage the upper surfaces of the trunnions (90) (not as shown in figure 6 where the washer is illustrated beneath the trunnions). The firing spring (80) therefore acts on the washer (78) tending to move the trunnions (90) downwardly in the slots (104). However this is not possible in the "REST" position shown in figure 7A where the balls (106) on the piston (96) block inward rotation of the latch member (86) and therefore prevent the trunnion assembly from pivoting downwardly under the action of the firing spring. In this "REST" position the cap (28) is urged upwardly by the return spring (82) which acts between the washer (78) and the abutment (74) on the housing wall.

To bring the device into the "COCKED" position as shown in figure 7B, the cap (28) is manually depressed. However owing to the frictional engagement between the latch member (86) and the co-

operating ball (106), the piston (96) remains in its elevated position. On inhalation through the mouthpiece (14), the piston (96) is moved downwardly to disengage the balls (106) from the latch (86) as illustrated in figure 7C. The device is then brought into the "FIRED" condition in which the firing spring (80) is then free to act on the washer (78) thereby driving the trunnions (90) downwardly in the slots (92) and at the same time engaging the base of the aerosol can (12) to move it downwardly until its valve is opened thereby discharging a dose of medicament. With the piston (96) in its lowered position, the respective ball (106) is then moved nearer to the pivot point of the latch member (86) so that it is clear of the head portion of the latch member which can then pivot inwardly as shown in figure 7D.

The reaction post (94) acting on the other balls (106) provides a thrust surface which enables the device to remain in its "COCKED" position as shown in figure 7B with the required frictional engagement then acting between the head portion of the latch member (86) and its co-operating ball (106) until inhalation at the mouthpiece (14) takes place resulting in discharge of a dose of medicament into the inhaled airstream.

After inhalation of a dose of medicament, the device is reset by releasing the downward pressure on the cap (28) whereby the relatively weak return spring (82) can now act on the washer (78)

to move the cap (28) upwardly relative to the inhaler housing (10) until the abutment (76) engages the annular pawl (74) at the end of the cap wall. As the cap (28) moves upwardly under the action of the spring load acting on the valve of the aerosol can, it lifts the piston (96) with it as a result of an engagement between an annular internal flange (96A) provided on the piston (96) in an elongate annular recess (28A) formed in the outer periphery of the depending boss (98) provided on the cap (28). In this way the actuator is then brought into the "REST" position shown in Figure 7A of the device ready for a subsequent actuation thereof.

A fifth embodiment of an actuator for an aerosol can is shown in figures 8 and figures 9a to 9c. This unit is in the form of a self-contained actuator unit which is intended to be fitted on top of the basic housing of a metered dose inhaler which contains an aerosol can and has at its lower end a mouthpiece through which medicament is inhaled in an airstream.

The actuator is similar in construction and operation to the actuator described above with reference to figures 1 and 2a-2C and the same reference numerals will be used for similar parts.

The actuator unit comprises a cap (28) having air inlets (30) therein. The cap (28) has a cylindrical wall (108) which engages around the upper portion of the housing wall. The housing wall

is provided with an annular recess (110) and the cylindrical wall of the cap has an inwardly projecting rib (112) which engages in the recess (110) to allow a limited sliding movement of the cap (28) on the housing (10) whilst retaining the cap thereon.

The actuator unit further comprises a cylindrical latch device (18) which is generally cup-shaped having a downwardly open mouth and receives therein an upper portion of the aerosol can (12). A series of four circumferentially spaced resilient latching members (22) are integrally formed on the cup member together with a central upwardly projecting hollow boss (24).

The resilient latch members (22) have a T-shaped head portion (22A) with a retaining rib (22B) formed on the upper surface thereon.

The actuator further comprises a piston member (26) having an annular upper portion (26A) which generally fits within an annular internal cylindrical portion (114) formed within the cap (28) around an annular depending wall (116). The air inlet apertures (30) communicate with the cylindrical chamber (32) within the cap.

The piston (26) has an annular depending section (26B) provided towards its lower end with an annular flange (26C) having a rounded rim (26D) for co-operating with the head portions (22B)

of the resilient latch members (22).

A driving spring (48) acts between the cap (28) and the latch device (18) and is of sufficient strength to move the aerosol can (12) axially by a sufficient amount to open the valve thereof to release a dose of medicament into an airstream inhaled in use through the mouthpiece (14).

The annular internal wall (114) of the cap (28) is formed with an annular retaining pawl (118) at its lower end for contacting an abutment (120) formed on the internal periphery of the piston (26) at one extreme of relative movement between those two parts.

The operation of the actuator will now be described with reference to figures 9A to 9C. Figure 9A shows the "SET" position of the device ready for release of a dose of medicament when an airstream is inhaled through the mouthpiece (14). In this position, the resilient head portions (22A) of the latch members (22) are engaged with the upper end of the annular housing wall and are held in this position by the rounded rim (26D) of the annular flange (26C) of the piston (26). The piston (26) is located at the lower end of the cylindrical chamber and is maintained in this position by a frictional engagement between the rounded rim (26D) of the flange (26C) with the co-operating surface of the head portions (22A, 22B) of the latch members

(22), in engagement with the underside of the surmounted ribs of those latch members. This frictional engagement which maintains the piston from dropping in this position, is achieved by selecting suitable angles for the co-operating surfaces between the latch member head portions (22A) and the upper surface of the housing wall and between the rounded rim (26D) of the piston flange (26C) and the juxtosposed surfaces of the latch member heads (22A). The angles of these co-operating surfaces are tuned in accordance with the friction co-efficients of the members concerned so that the piston (26) does not move in this position. With the latch device (18) held in the position shown in figure 9A by the engagement of the head portions (22A) of the latch members (22) with the upper end of the housing wall, the firing spring (48) is held sufficiently compressed to ensure that the valve of the aerosol can is not opened in this condition.

When an airstream is inhaled into the housing mouthpiece a pressure drop is experienced across the piston (26) so that it is moved downwardly to release the frictional engagement between the rim (26C) and the head portions of the resilient latch members (22) to bring the device into the "FIRED" condition shown in figure 9B. In this condition, the latch members (22) are now free to move resiliently inwardly and out of engagement with the upper end of the housing wall. This allows the latch members (22) to be moved downwardly by the firing spring (48) which causes axial depression of the aerosol can (12). This results in

opening of the valve of the aerosol can to dispense a dose of medicament into the inhaled airstream.

After inhalation of a dose of medicament, and release of the cap member (28) from the original manual force depressing it into the "SET" position, the firing spring (48) expands causing the cap (28) to move upwardly relative to the housing. Engagement of the annular pawl (118) on the cap with the abutment (120) on the piston (26) causes the piston (26) to be lifted as the cap (28) rises. The annular flange (26C) on the piston (26) initially contacts the undersides of the head portions (22B) of the latch members (22) thereby lifting the entire latch assembly, until the head portions (22A) are above the level of the upper end of the housing wall. This is caused by expansion of the spring associated with the valve of the aerosol can (12) which causes the aerosol can (12) and the latching assembly (18) mounted thereon to move upwardly to bring the latch member head portions (22A) above the top of the housing wall. The firing spring (48) then lifts the piston to splay outwardly the latching members (22) to engage the underside of the head portions (22B) and to bring the underside of the projecting portions (22A) of the ribs thereof above the upper end of the housing wall to bring the assembly into the "RESET" position shown in figure 9c.

The device is then brought into the "SET" position as shown in figure 9A, by manually depressing the cap (28).

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Advantages of the above described embodiments are a significantly simplified construction as compared to that of EP-0,045,419 with a reduction in the number of components required. The components are relatively robust so that they are less likely to break. Moreover the sensitivity of the device is relatively easily adjusted by tuning the engagement angles between the latching fingers and the cooperating abutment surfaces of the housing cap, and/or by altering the biassing spring acting on the control piston.

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CLAIMS

1. An actuator for use with a medicament dispensing device having a housing for receiving a medicament delivery system which can be operated by the actuator to deliver doses of medicament, and a nozzle through which doses of medicament are inhaled in use, the actuator comprising a body part containing at least one means for applying a force, or a cumulative force, to the medicament delivery system sufficient to cause delivery therefrom of a dose of medicament; releasable restraining means for restraining the, or at least one of the, force applying means to prevent application of a force, or cumulative force, to the medicament delivery system sufficient to deliver a dose of medicament, the restraining means including a latching device acting betwsen the, or said one, force applying means and said body part, and having a latching part which is movable generally transversely of the line of action of said force, between an engaged condition in which the restraining means restrains said force as aforesaid and a disengaged condition in which the restraining means is released with the latching part being biassed towards said disengaged position; and breath actuated control means for the restraining means, said control means being mounted in the body part for movement, under the influence of a reduced pressure acting thereon caused by inhalation at the nozzle, between a first position in which it blocks movement of said latching part to maintain it in said engaged condition, and, on the application thereto of said reduced pressure, a second position in which it disengages from, and moves clear of the path of movement of, the latching part allowing the latching part to move to said disengaged condition to release said restraining means.

2. An actuator according to Claim 1 wherein said control means comprises a member mounted in said body part for movement generally along the line of action of said force, under the influence of said reduced pressure.

3. An actuator according to Claim 1 or Claim 2 wherein said latching part is engageable with an abutment provided on said body part in said engaged condition thereof.

4. An actuator according to Claim 3 wherein said latching part and said abutment have cooperating abutment surfaces which are set at an angle to the line of action of said force so as to bias the latching part towards said disengaged condition under the action of said force applying means.

5. An actuator according to Claims 2 to 4 wherein the piston includes biassing means biassing it towards said first position.

6. An actuator according to any one of Claims 1 - 5 including a first force applying means for applying a preload to the medicament delivery system which is insufficient to cause delivery therefrom of a dose of medicament, and a second force applying means which is restrained by said releasable restraining means, said first and second force applying means being capable of applying a cumulative force to said medicament delivery system, on release of said restraining means, sufficient to cause discharge therefrom of a dose of medicament.

7. An actuator according to any one of Claims 1 - 6 wherein said latching device is integral with a thrust member, on which said one force applying means acts, said thrust member together with the latching device being movably mounted in said body part for movement generally along the line of action of said force, when said latching part is moved to said disengaged condition thereof.

8. An actuator according to Claim 7 wherein said latching part is resilient to allow movement thereof between said engaged and disengaged conditions thereof.

9. An inhaler having a generally tubular housing for receiving a medicament delivery system, and a nozzle which communicates with one end of the housing and through which doses of medicament are inhaled in use, and an actuator according to any one of Claims 1 to 8 for actuating a medicament delivery system located in use in said housing to deliver doses of medicament for inhalation at the nozzle.

10. An inhaler as claimed in Claim 9 wherein the body part of the actuator comprises a cap located at the other end of the housing.

11. An inhaler as claimed in Claim 10 wherein the cap is fixed with respect to, or integral with, said housing.

12. An inhaler as claimed in Claim 11 wherein engageable abutment means are provided between said control means and said latching part, and resilient engagement means are provided for releasably engaging said control means with a part of said cap, during resetting of the actuator.

13. An inhaler as claimed in claimed in Claim 10 wherein the cap is movably mounted on the housing, for setting and resetting the actuator.

14. An inhaler as claimed in Claim 13 wherein engageable abutment means are provided between the cap and said control means and between said control means and said latching part for resetting the actuator when the cap is lifted with respect to the housing.

15. An inhaler as claimed in Claim 11 which includes a movable portion mounted on the cap and operable to depress an internal axially movable member within the housing in order to expose inlet air holes in that member, and to set the actuator.

16. An actuator for use with a medicament dispensing device, the actuator being substantially as herein described with reference to Figures 1 and 2a to 2c; Figures 3a to 3c and Figure 4; Figures 5a to 5c; Figures 6 and 7a to 7e; and Figure 8 and Figures 9a to 9c of the accompanying drawings.

17. An inhaler substantially as hereinbefore described with reference to Figures 1 and 2a to 2c; Figures 3a to 3c and Figure 4; Figures 5a to 5c; Figures 6 and 7a to 7e; and Figure 8 and Figures 9a to 9c of the accompanying drawings.

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Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9418064.3
Relevant Technical Fields (i) UK Cl (Ed.N) A5T (TBD, TBE) (ii) Int Cl (Ed.6) A61M 15/00	Search Examiner L V THOMAS
	Date of completion of Search 27 OCTOBER 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI	Documents considered relevant following a search in respect of Claims :- 1-17

Categories of documents

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Category	Identity of document and relevant passages		Relevant to claim(s)
A	EP 0045419 A1	(FISONS LTD) see page 4 line 25 - page 5 line 14 and page 6 lines 2-15	1

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